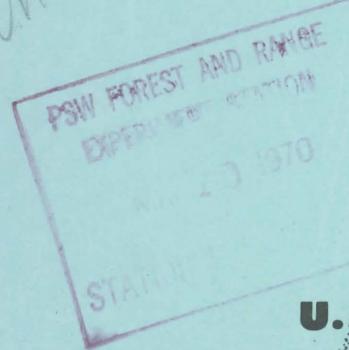
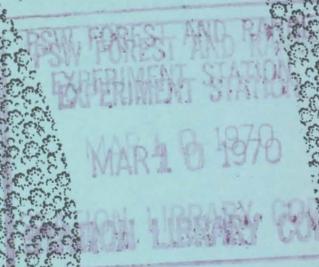


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# THE USE OF 2,4-D & 2,4,5-T FOR BRUSH CONTROL ON CALIFORNIA ROADS & TRAILS



U.S. DEPT. OF AGRICULTURE  
FOREST SERVICE

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Compiled from results of studies by the Experiment Station and from pilot tests by the authors on the Shasta National Forest and by Gustaf Juhren, Angeles National Forest, on the Angeles and San Bernardino National Forests.

RMO

The Use of 2,4-D and 2,4,5-T for

## BRUSH CONTROL

On California Forest Roads and Trails

**SPROUTING BRUSH** and brush seedlings on forest roadsides, trails, firebreaks, and rights-of-way have kept maintenance costs high. Clearing by cutting or bulldozing must be done over and over again, because the rapid regrowth of most species is from 2 to 6 feet within a few years. Their density also tends to increase with the apparently beneficial "pruning" effect of cutting.

**SELECTIVE HERBICIDES** such as 2,4-D (2,4-Dichlorophenoxyaceticacid) were found to be highly successful in ridding farm crops of broadleaf weeds. Would they kill brush? The California Forest and Range Experiment Station decided to find out. Beginning in 1945 test plots were established all over the state. These were treated under a variety of conditions with many concentrations of chemical. In 1949 2,4,5-T (2,4,5-Trichlorophenoxyaceticacid), now known as the "brush killer," was added for testing. Plots were sprayed with 2,4,5-T alone and in combination with 2,4-D.

**PRACTICAL TESTS.** In the spring of 1950, 140 miles of road shoulders on the Shasta National Forest, previously cut with a brush mower or bulldozed, were sprayed with mixtures of 2,4-D and 2,4,5-T in diesel oil. The treatments were based on observation of results of the test plots and varied in strength to take care of the most resistant species in each area.

This was done with no expectation that all the brush would be completely eradicated—but with the knowledge that some would be and that all of the plant above the ground could be killed. In short, the aim was for control rather than for complete kill.

Records were kept on all costs in order to establish a basis for future cost estimating.

On the Angeles and San Bernardino National Forests 150 miles were sprayed in 1949 and 1950 with a commercial mixture of 2,4-D and 2,4,5-T in diesel oil following cutting of the roadside brush by a brush mower.

Chemical treatment of cut brush along forest trails involve different methods and equipment because of the problem of hauling and packing sufficient volumes of 2,4-D and 2,4,5-T acid and carrier. Not enough actual work has been done of a practical nature to include a cost estimate, but suggestions based on several miles of trail spraying in 1950 on the Angeles and San Bernardino National Forests and a description of the work are included here.

Because both control and some kill are possible with 2,4-D and 2,4,5-T their use is entirely justified as a maintenance measure—BUT—in order to maintain control and eliminate the need for future cutting or clearing, planned treatments must be done on a long-term basis. It is necessary to respray most treated areas, but how often will depend on results of the initial chemical treatment.

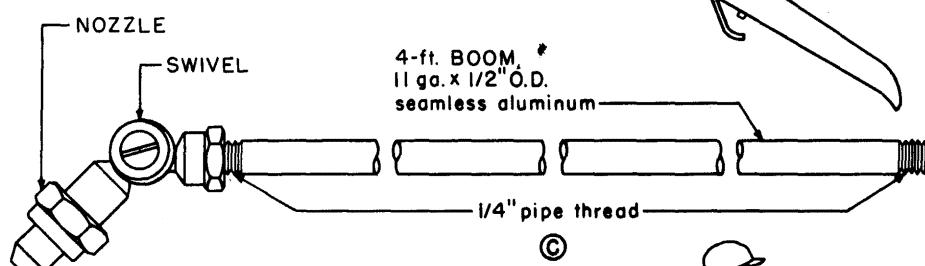
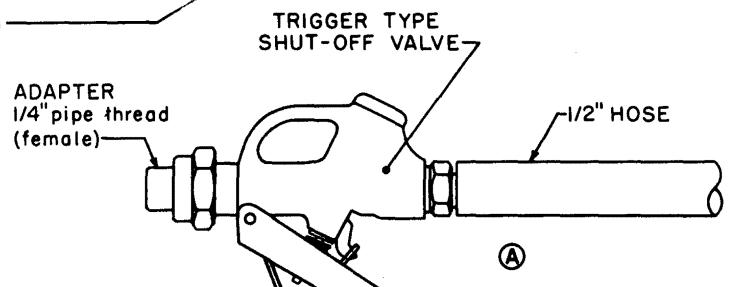
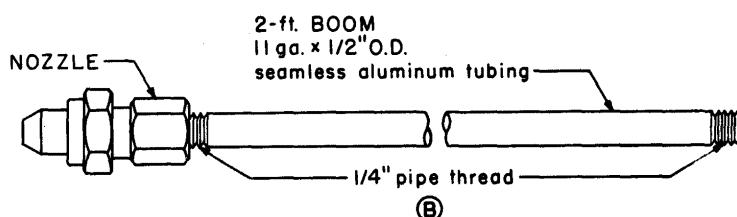
All forests having previously cut or cleared brush from roads, trails or firebreaks are ready to begin a long-term chemical control program. The instructions outlined here will tell how and when.

Descriptions and costs of the work done on the Shasta, Angeles and San Bernardino National Forests are also included on following pages.

- THESE  
INSTRUCTIONS -** contain practical information on the use of the herbicides 2,4-D and 2,4,5-T for the control of brush regrowth on:
- roadsides and trails which have been previously cut or mowed.
  - roadsides, firebreaks or rights-of-way which have been bulldozer-cleared.
  - road shoulders which have been bladed.

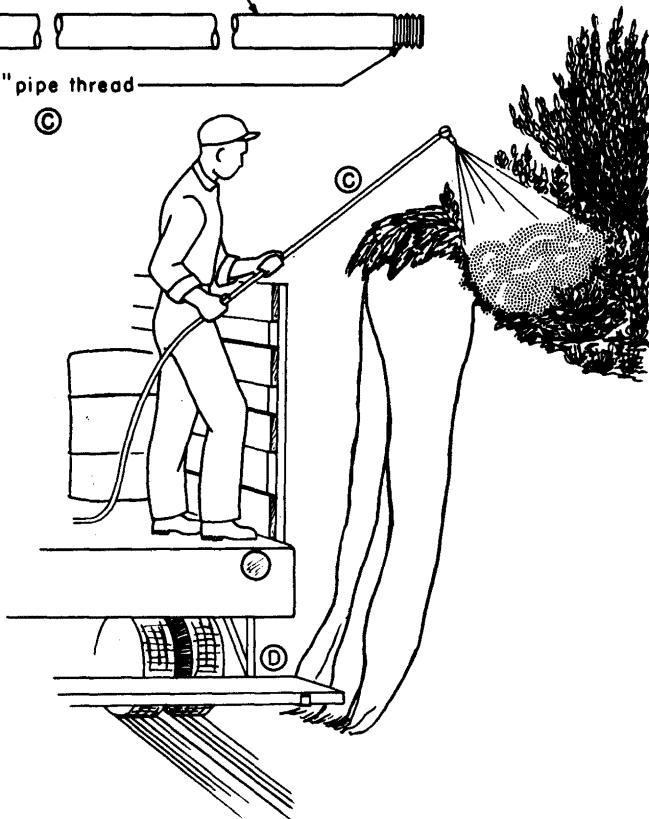


Use trigger type shut-off **(A)**, a short boom and solid cone nozzle **(B)** for total coverage with the least amount of chemical and carrier.



Substitute longer boom and swivel fitting **(C)** for spraying high banks.

Mount a low step **(D)** for riding short distances between spray strips.



## *A Practical Plan*

for carrying out a chemical brush-control program after cutting can be set up according to the following suggestions for:

## *Equipment*

### ★ AVAILABLE ON MOST FORESTS:

- 1 - fire pump that will develop up to 250 p.s.i.
- 1 -  $1\frac{1}{2}$ -ton stakeside truck
- 2 - "MEN WORKING" signs
- Miscellaneous iron pipe fittings

### ★ CAN BE PURCHASED:

- 2 -  $2\frac{1}{4}$ " lengths of  $\frac{1}{2}$ " O.D. 11-gage seamless aluminum tubing with  $\frac{1}{4}$ " iron pipe threads
- 1 - 4-ft. length of  $\frac{1}{2}$ " O.D. 11-gage seamless aluminum tubing with  $\frac{1}{4}$ " iron pipe threads
- 1 - length of 1" oil-proof suction hose (long enough to reach from pump to drum)
- 2 - 10-foot lengths of oil-proof  $\frac{1}{2}$ " high pressure hose
- 2 - "trigger" type shut-off valves
- 4 - solid cone nozzles  $30^{\circ}$  angle of spray,  $\frac{1}{4}$ " pipe female connection; discharge 1.1 GPM at 100 p.s.i.
- 4 - swivel fittings to fit the above nozzles
- 1 - two-quart measure
- 1 - one-quart measure
- 1 - one-pint measure

### ★ CAN BE FABRICATED:

- 1 - step, mounted across the back of the truck 8 to 12 inches wide, approximately a foot above the ground. A step such as this provides a convenient place for a spray man to ride when there is no brush to spray on his side of the road.
- 1 - stick  $\frac{1}{4}$  feet long, calibrated for measuring from 10 to 50 gallons of oil in a 50-gallon drum.

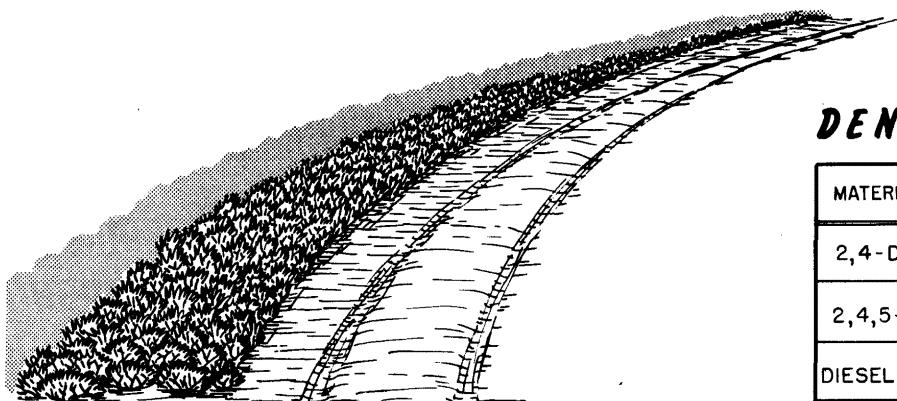
Mount the pump on a rear corner of the truck bed in order to leave room for 8 fifty-gallon oil drums—an average day's supply.

The truck and pump can be converted to other uses, such as fire-fighting, on short notice.

#### A GUIDE FOR ESTIMATING:

The tables below show the amounts of chemical and oil carrier needed to spray both sides of one mile of road with four feet of brush on each side.

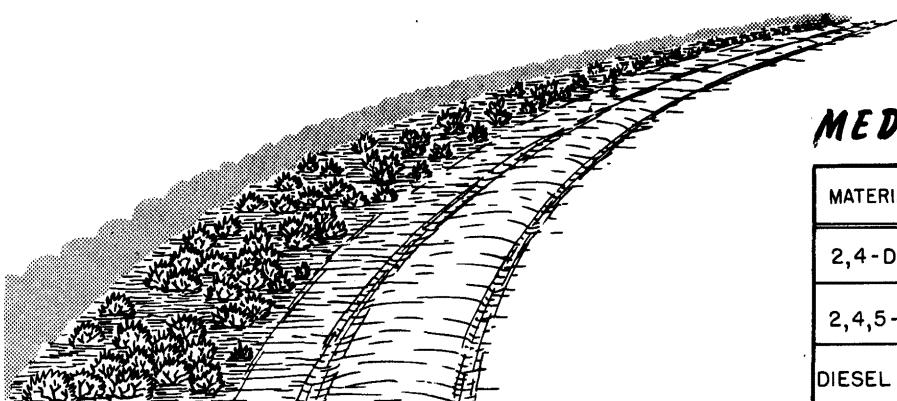
(See page 13 for definition of  
Hard-to-kill and Easy-to-kill)



Continuous spraying

#### DENSE brush regrowth

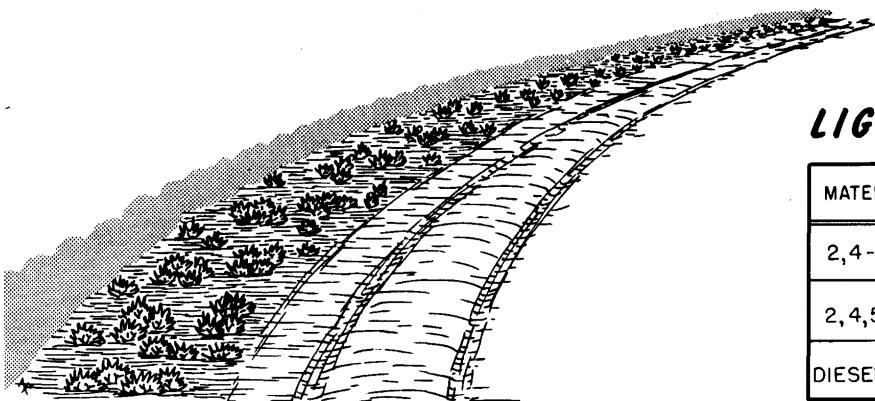
MATERIAL	HARD-TO-KILL SPECIES	EASY-TO-KILL SPECIES
2,4-D	1.6 lbs.	1.6 lbs.
2,4,5-T	6.4 lbs.	3.2 lbs.
DIESEL OIL	100 gal.	100 gal.



Some continuous - some intermittent spraying

#### MEDIUM brush regrowth

MATERIAL	HARD-TO-KILL SPECIES	EASY-TO-KILL SPECIES
2,4-D	0.8 lbs.	0.8 lbs.
2,4,5-T	3.2 lbs.	1.6 lbs.
DIESEL OIL	50 gal.	50 gal.



Intermittent spraying

#### LIGHT brush regrowth

MATERIAL	HARD-TO-KILL SPECIES	EASY-TO-KILL SPECIES
2,4-D	0.4 lbs.	0.4 lbs.
2,4,5-T	1.6 lbs.	0.8 lbs.
DIESEL OIL	25 gal.	25 gal.

## *Planning*

### ► SIZE OF JOB

Map the miles of roads with brush regrowth ready for spraying this year (See pages 14 and 15).

Using a red pencil, mark as top priorities those which must be sprayed this season to avoid mechanical mowing; i.e., those near maximum height. The final plan should include all these if possible.

Using a different color, add as many roads ready for spraying—but which could be deferred a year or two—as funds and manpower will permit.

### ► HOW MUCH CHEMICAL

For each road estimate the pounds of chemical and gallons of oil needed according to the guides on the opposite page (See page 9 for information on how to buy).

### ► JOB TIMING

Divide the roads planned for spraying this year into zones of different seasonal growth periods (See page 15).

### ► CREWS

An efficient spray crew consists of 4 men:

3 spray-men who can alternate with each other driving truck and spraying and

1 foreman who will supervise the job, keep a close check on coverage and make all entries on the Brush Spray Daily Record sheets.

AD-38

Approved: September 21, 1943

Method of Purchase Form Approved Budget Bureau No. 48-R101 Indicate Method by Number: 1. General Schedule of Supplies 2. Treasury Procurement Stock 3. Surplus Property Transfer 4. Advertising (R. S. §3709) 5. War Powers Negotiation 6. Other Exemption from R. S. §3709 7. Miscellaneous (See Treasury Procurement Circular Letter No. 722)		<p style="text-align: center;"><b>PURCHASE ORDER</b></p> <p style="text-align: center;">U. S. DEPARTMENT OF AGRICULTURE</p> <p style="text-align: center;">Forest Service</p>		<p style="text-align: right;">This number must appear on all PACKAGES and PAPERS relating to this order.</p> <p style="text-align: center;">Order No.</p> <p style="text-align: center;">Date</p>			
Requisition No.		Appropriation Symbol and Title  Allotment					
Unless otherwise specified, only American made, grown or produced goods are acceptable under this purchase order and vendor guarantees that in filling this order his deliveries will conform to this requirement.							
To S E L L E R		Consignee and Destination S H I P T O					
Invitation No.		Contract No.		Time for Delivery		Discount Terms	
Fob Point		Ship Via		Gov't B/L No.			
Item No.	Articles or Services			Quantity	Unit	Unit Price	Amount
1	2,4-D Isopropyl butyl ester or equivalent			50 lb.	acid equivalent		
2	2,4,5-T Propylene glycol butyl ether ester or equivalent low volatile ester			180 lb.	acid equivalent		
(Both chemicals to be in form readily miscible with diesel oil.)  Supply in 5-gallon drums.							

## *Buying Chemicals*

\* To estimate how much you will need, see pages 6 and 7.

\* Order 2,4-D and 2,4,5-T by the pound of acid equivalent.

The number of pounds of acid equivalent varies with manufacturers.

\* Order the separate esters of 2,4-D and 2,4,5-T.

Do not order commercial mixtures of the two chemicals.

\* Specify low volatile ester of 2,4,5-T.

\* Specify the size containers most practical for the job.

2,4-D and 2,4,5-T esters are available in 50-gallon and 28-gallon drums and in 5-gallon cans.

\* \* Order diesel oil in 50-gallon drums from the local distributor.

In Region 5 submit requisition showing pounds of each ester, container size and shipping point to the Regional office. Central purchase will be made from there.

BRUSH SPRAY DAILY RECORD

Forest Shasta

Date 7-9-50

Sheet No. 1

Pounds of acid equivalent per gallons of 2,4-D 3.34; 2,4,5-T 4.0 (From container label)

Road number	50-gal. Drum No.	Quarts		Gals. Used	Speedometer Reading		Miles	1 or 2 Sides
		2,4-D	2,4,5-T		Begin	End		
2117	1	1	1 5/8	42	9377.6	9378.6	1.0	1 3/4
"	1	-	-	8	9380.6	9381.1	0.5	1/2
"	2	1	1 5/8	50	9381.1	9382.0	0.9	2
3	1	1 5/8	50	9382.0	9383.6	1.6	1	
4	2	3 1/4	50	9385.3	9385.9	0.6	2	
5	2	3 1/4	50	9385.9	9386.7	0.8	2	
6	2	3 1/4	50	9386.7	9387.9	1.2	1 1/2	
7	1	1 5/8	21	9387.9	9388.3	0.4	1 1/2	
7	-	-	29	9390.3	9391.1	0.8	2	
TOTALS		10	16 1/4	350		7.8		

C O S T S

LABOR		
Unskilled hrs.	16	\$24.00
Skilled hrs.	2	3.24
Foreman	8	16.88
TOTAL	26	44.12

MATERIALS		
Gals. Diesel	350	\$45.50
Qts. 2,4-D	10	8.90
Qts. 2,4,5-T	16 1/4	31.69
TOTAL	-	86.09

EQUIPMENT		
S.S. Truck mi.	27	\$5.40
P.U. Truck mi.	32	2.40
Other	-	-
TOTAL	-	7.80

TOTAL COST \$138.01  
COST PER MILE 17.69

INSTRUCTIONS

Complete all entries at top of form.

To find pounds of acid equivalent per gallon read the manufacturer's label on the chemical container.

Column Nos.

- (1) ROAD NUMBER. Enter forest road number.
- (2) DRUM NO. Number consecutively each full drum from beginning to end of spraying season.
- (3) QUARTS OF 2,4-D - 2,4,5-T. Enter amount of chemical added to drum of oil in quarts and/or fractions of quarts as shown in table.
- (4) GALS. USED. Enter 50 for each full drum. If not full drum, enter gallons used.
- (5) SPEEDOMETER READING. Enter speedometer mileage at beginning and ending of each drum or road.
- (6) MILES. Enter difference between figures in Column 5.
- (7) 1 OR 2 SIDES. Enter 1 or 2 sides of road or fractions from 0 to 2.

Enter totals of Columns 3, 4 and 6 at the end of each day.

C O S T S

Complete all entries on each record sheet for each day.

## *Record Keeping*

- THE BRUSH SPRAY DAILY RECORD sheet shown on the opposite page is kept current in the field by each crew foreman.

Because it is also a permanent record to be filed at headquarters for cost accounting and checking it is recommended that:

1. The sheets be numbered in one continuous series from beginning to end of each spraying season.
2. A new sheet be started for each road.



- MAP RECORDS. At the end of each spraying season color a Forest map to show the total mileage sprayed, using a different color for each year. Road numbers and distances can be read from the daily record sheets.

If the same road is sprayed a second or third time, show in the color for that year by hatches as:



- SUMMARIES. Prepare for permanent record a summary sheet showing by road project numbers the total mileage sprayed and the total and per mile costs of labor, equipment and materials.

**QUARTS OF 2,4-D OR 2,4,5-T  
PER 50 GALLONS OF DIESEL OIL**

CONCENTRATION IN ppm	POUNDS OF ACID EQUIVALENT PER GAL. <small>(From container label)</small>				
	3	3.34	4	4.5	5
2,000	1	1	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{2}{3}$
4,000	2	2	$1\frac{5}{8}$	$1\frac{1}{2}$	$1\frac{1}{4}$
6,000	$3\frac{1}{4}$	3	$2\frac{1}{2}$	$2\frac{1}{8}$	2
8,000	$4\frac{1}{4}$	$3\frac{7}{8}$	$3\frac{1}{4}$	$2\frac{7}{8}$	$2\frac{1}{2}$
10,000	$5\frac{1}{3}$	$4\frac{3}{4}$	4	$3\frac{1}{2}$	$3\frac{1}{4}$
12,000	$6\frac{1}{2}$	$5\frac{3}{4}$	$4\frac{3}{4}$	$4\frac{1}{4}$	$3\frac{7}{8}$
16,000	$8\frac{1}{2}$	$7\frac{2}{3}$	$6\frac{1}{2}$	$5\frac{5}{8}$	$5\frac{1}{4}$
20,000	$10\frac{2}{3}$	$9\frac{1}{2}$	8	$7\frac{1}{8}$	$6\frac{1}{2}$

ppm = parts per million = pounds acid equivalent per  
million pounds of carrier.

## *Adjusting Concentrations*

Higher concentrations increase the possibility of root kill below the ground in some species. Complete kill above the ground is possible with all concentrations shown in the table on the opposite page, if spray application is efficient.

It would not be possible to list all woody species found on California roadsides and trails according to the degree of their susceptibility to 2,4-D or 2,4,5-T. The same shrub varies in susceptibility from one locality to another—sometimes from one slope exposure to another.

Wherever HARD-TO-KILL plants predominate such as sumac, blackberry, chamise, poison oak; or any plant that is known to be a fast growing, prolific sprouter from a burl or root crown, use:

A concentration  
consisting of:

{ 8000 ppm 2,4,5-T acid equivalent  
2000 ppm 2,4-D acid equivalent  
in diesel oil

Wherever EASY-TO-KILL plants predominate such as seedlings, or slow growing, weak sprouting species not included in the above list, use:

A concentration  
consisting of:

{ 4000 ppm 2,4,5-T acid equivalent  
2000 ppm 2,4-D acid equivalent  
in diesel oil

When in doubt keep the 2,4,5-T content high.

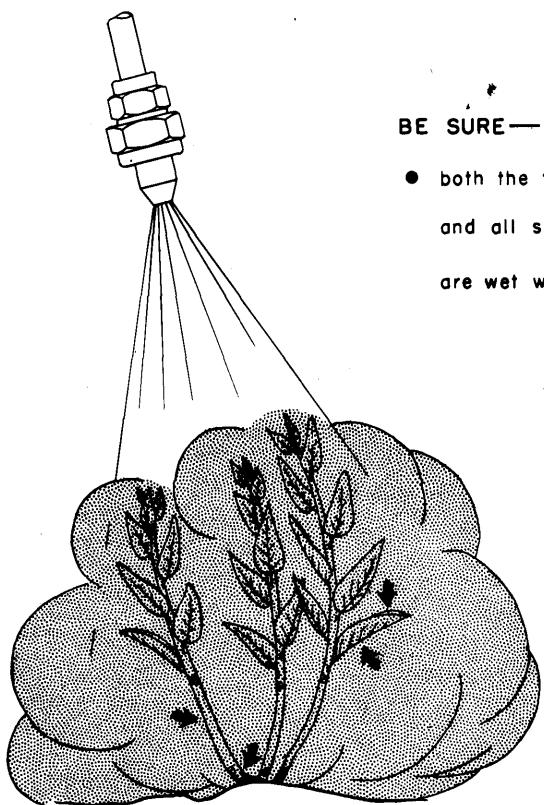
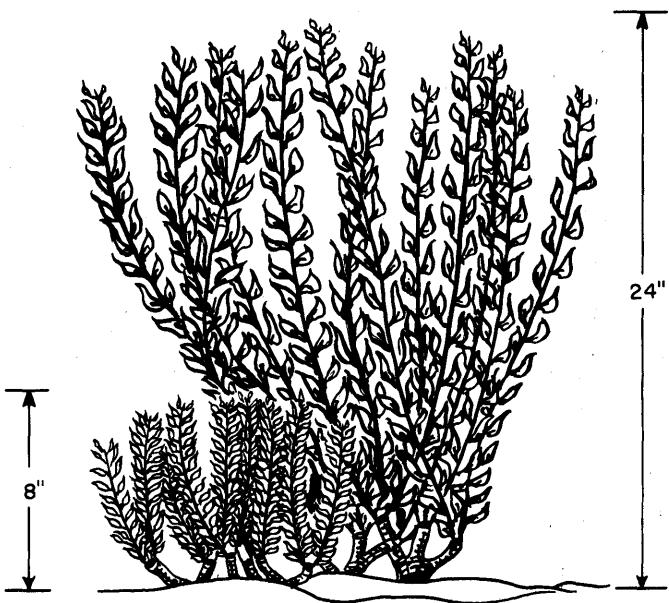
Commercial ester formulations of 2,4-D and 2,4,5-T contain different amounts of acid equivalent per gallon. Concentrations are calculated on the basis of these acid equivalents. The columns in the table on the opposite page are headed with the common acid equivalents available. For each desired concentration read the amount of chemical in quarts from the appropriate column in the table.

For example: If you are to use a concentration of 4,000 ppm 2,4,5-T and 2,000 ppm 2,4-D and your chemical container labels read 4.0 pounds acid equivalent per gallon, use 1-5/8 quarts of 2,4,5-T and 3/4 quart of 2,4-D per 50 gallons of oil carrier.

### **BRUSH REGROWTH**

8" to 24" in height—

- in a stage of rapid growth—
- with all leaves fully formed—  
is ready for spraying with  
2,4-D; 2,4,5-T and diesel oil.

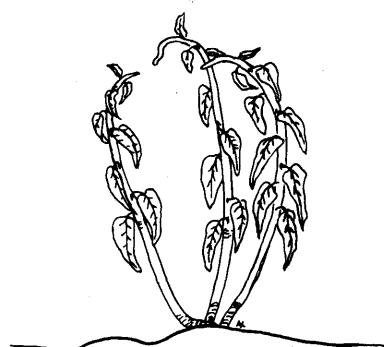


### **BE SURE—**

- both the tops and the undersides of leaves  
and all surfaces of stems to ground level  
are wet with spray.

Efficient spray application means  
complete kill above the ground—

—maximum root kill.



**100% COVERAGE = 100% CONTROL**

## *When to Spray*

When to spray brush regrowth is determined by:

★ HEIGHT. Plants should not be sprayed before they are 8 inches high so that they will have enough leaf surface to absorb the chemical for translocation down into the root system. Sprout growth can be controlled economically with chemicals up to a height of 24 inches.

★ STAGE OF GROWTH. Spray all plants during the time when they are growing rapidly but not before the leaves are fully formed.

The stage of most rapid growth usually occurs early in the season. Fast-growing species, however, may be sprayed any time during the first year after cutting.

Season is controlled by altitude. The higher the altitude the later the growing season. As a basis for planning, each area should be zones. Roads located in low altitude zones can be sprayed as early as April or May—those in high altitudes as late as August or September—so that each year's spray program can continue without interruption throughout the field season.

## *How to Spray*

100% COVERAGE = 100% CONTROL

- ★ Keep pressures high enough to insure spray turbulence and misting.
- ★ Cover all leaf and stem surfaces to ground level with spray.
- ★ If the growth is dense, get down into it, using your short boom to pull it apart as you spray.
- ★ Hold the nozzle close to the shrub so that the spray mist will not be blown away or wasted.
- ★ Travel slowly so that you can see what you are spraying and know when the spray is covering the plant.
- ★ Check back after spraying from time to time to find out what degree of coverage you are getting.

## *Retreatments*

When to retreat will be the same as indicated for when to spray with one exception:

Concentrations may be decreased for all species to:

4,000 ppm 2,4,5-T  
1,000 ppm 2,4-D  
in diesel oil.

Resprouting after initial chemical spray treatment will usually be weaker, less dense, and more delayed than sprouting after cutting. BUT—follow-up control treatments must be planned and carried out on a long term basis so that mechanical cutting will not be necessary.

## *Cautions!*

Chemical sprays containing 2,4-D and 2,4,5-T will kill desirable plants, too. Do not use them adjacent to agricultural areas or near ornamental shrubs. Spray has been known to drift, killing crops several miles away.

Place "MEN WORKING" signs to warn vehicles on narrow or well traveled roads.

A WORD TO A WISE SPRAY-MAN. The clothes you wear while spraying will become saturated with oil and chemical. Wash them often to prevent skin irritation. Never wear them for fire fighting!

## **TRAILS**

The planning of a chemical brush control program for forest trails can be based on the suggestions given for roads, as far as size of job, buying chemical, when and how to spray and follow-up treatments are concerned—but owing to the inaccessability of most trails to motor vehicles, changes must be made in equipment and quantity of material to make packing, distribution and carrying possible.

Chemical control work on trails has not been carried out on a large scale in California. The following suggestions are based on experimental work only:

**EQUIPMENT** (Note: The CO<sub>2</sub> power bottle equipment illustrated in the last section of this publication is no longer available.)

A FEDCO type 4-gallon back-pump fitted with a solid cone nozzle having a discharge rate of 0.20 gallons per minute will provide good coverage. It is easy to operate, light to carry, and pressure can be maintained at the 35 to 40 pounds needed for efficient spraying.

### **CHEMICAL AND OIL CARRIER**

Higher concentrations of chemicals and lower volumes are more practical for chemical control spraying on trails.

Application should be at the rate of 10 gallons of diesel oil per mile of trail with four feet of brush on each side.

Chemical and oil can be mixed in 50-gallon drums, drained into smaller containers, and distributed to spray-men by pack train or jeep.

Remember, when estimating amounts of chemical and oil needed—where 50 gallons of oil was sprayed over 1 mile of medium growth on roads—on trails 50 gallons must cover 5 miles.

So that an equal amount of chemical is applied per shrub on trails as on roads, the concentration must be increased to:

40,000 ppm 2,4,5-T  
20,000 ppm 2,4-D  
in 50 gallons diesel oil.

(For concentrations over 20,000 ppm, read the table on page 12 for 10,000 ppm and multiply.)

CHEMICAL BRUSH CONTROL WORK ON ROADSIDES  
ON THE SHASTA NATIONAL FOREST, 1949-1950

In 1950, based on the experience obtained from the experimental work of previous years, some 70 miles (140 miles on road shoulders) of treatment were done on a project basis. Forty miles had been cut by a mowing machine and hand-work in 1949. The new growth was anywhere from 6 to 24 inches high. Complete top kill was achieved. Thirty miles had been cleared with a bulldozer in 1946 and 1947, and at the time of treatment the new growth consisted almost entirely of seedlings up to 36 inches high. Complete top kill was also obtained. More time will have to elapse before the amount of root kill can be determined. However, based on the results observed in 1950 of the experimental work done in 1949, we expect a large percent of the complete kill.

APPLICATION

The roads treated were generally on flat terrain so that there were either low cut and fill banks or none at all. Two men (one on each side), each with 3/8-inch oil-proof rubber hose equipped with a trigger type control valve, walked along the road and sprayed a strip 4-5 feet wide.

SEASON

The work in 1949 was done in the last week of July and the first week of August. The 1950 work was done in the month of July.

CHEMICAL AND MIXTURES

Diesel oil was mixed with 2,000 p.p.m. of 2,4-D acid and 4,000 p.p.m. of 2,4,5-T acid. For some of the more resistant species the 2,4,5-T was increased to 8,000 p.p.m.

PRESSESURES AND NOZZLES

Pressure of 100 p.s.i. in conjunction with a solid cone, 30° angle nozzle delivering 1.1 gallons per minute, was found to be satisfactory.

## SPEED

Walking speed. The men walked along the road, one on each side. Their rate of travel depended on the density of the brush. Complete coverage was the objective rather than distance to be covered in a given time. The crew treated from 6 to 8 miles—both sides—per working day.

## EQUIPMENT

1. A  $1\frac{1}{2}$ -ton stakeside truck.
2. A power unit borrowed from fire control consisting of a 5-horsepower, air-cooled, 4-cycle engine directly connected to a 2-stage centrifugal pump, capable of pressures up to 250 p.s.i. A piece of  $1\frac{1}{2}$ -inch pipe 42 inches long, attached to  $1\frac{1}{4}$ -inch oil-proof suction hose was used to connect the pump to the supply, contained in 50-gallon oil drums.
3. Six to eight standard oil drums of 50-gallon capacity, filled with diesel oil sufficient for a day's supply.
4. A supply of 2,4-D and 2,4,5-T each in 5-gallon cans.

The equipment is shown in the pictures below and on the following page.





#### COMMENTS

The methods, concentrations, volumes, etc., outlined in the foregoing are quite practical, and with slight variations as conditions dictate can be used on the northern California forests. While it is too early to conclude that all species can be killed, the results of previous years' work indicate that chemical treatment is wholly justified as a maintenance measure in that it will materially reduce the annual cost of roadside clearing.

#### COSTS

Costs varied with the density of the brush, from a low of \$15.00 to a high of \$35.00 per mile at 1950 prices.

The width of strip treated was 5 feet each side or 10 feet per lineal foot of road, which equals 1.25 acres per mile. The treatment was a spray of 2,4-D and 2,4,5-T in diesel oil.

Shown below are pictures and typical examples of costs for treating light, medium, and dense growth. It should be kept in mind that chemical prices may have advanced and labor rates increased since the summer of 1950, and that costs here presented will increase accordingly.



Light — Length of Project: 2.5 miles

Cost to cut by mowing machine and hand work: \$128 per mile

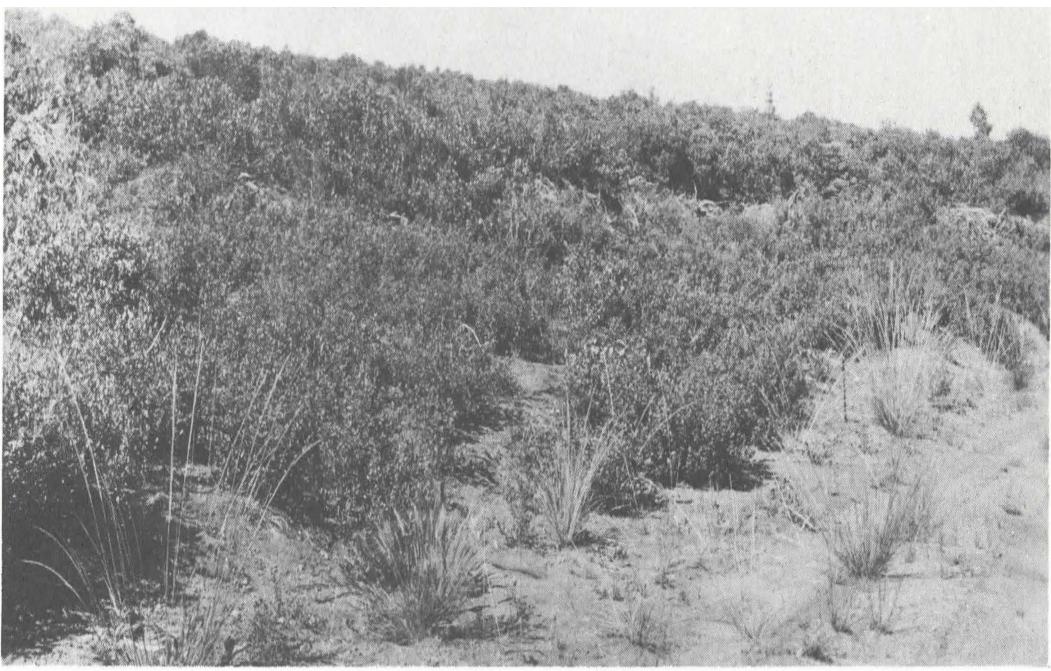
Labor: *	3 hrs. at \$1.50	\$ 4.50
	1 hr. at \$1.62	2.43
	1½ hrs. at \$2.11	<u>3.16</u>
		\$10.09

Equipment:	3.15
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Materials:	Diesel oil, 106 gals. at \$0.13	13.78
	2,4,5-T, 4 qts. at \$1.95	7.80
	2,4-D, 2 qts. at \$0.89	<u>1.78</u>
		<u>23.36</u>
		\$36.60

Cost per mile, both sides, \$14.64

\*Hourly labor rates allow for annual leave, sick leave, and holidays.



Medium — Length of Project: 8.1 miles  
Cost to cut by mowing machine and hand work: \$165 per mile

\*  

Labor:*	16 hrs. at \$1.50	\$24.00
	8 hrs. at \$1.62	12.96
	8 hrs. at \$2.11 (Foreman)	<u>16.88</u>
		\$ 53.84
Equipment:		10.29
Materials:	Diesel oil, 477 gals. at \$0.13	62.01
	2,4,5-T, 18 qts. at \$1.95	35.10
	2,4-D, 9 qts. at \$0.89	<u>8.01</u>
		<u>105.12</u>
		\$169.25

Cost per mile, both sides, \$20.90

\*Hourly labor rates allow for annual leave, sick leave, and holidays.



Dense — Length of Project: 4.2 miles

Cost to cut by mowing machine and hand work: \$382 per mile

Labor:*	16 hrs. at \$1.50	\$24.00
	8 hrs. at \$1.62	12.96
	8 hrs. at \$2.11 (Foreman)	16.88
		<b>\$53.84</b>

**Equipment:** 9.40

Materials:	Diesel oil, 373 gals. at \$0.13	48.49
	2,4,5-T, 14 qts. at \$1.95	27.30
	2,4-D, 7 qts. at \$0.89	<u>6.23</u>
		<u>82.02</u>
		\$145.24

Cost per mile, both sides, \$34.60

\*Hourly labor rates allow for annual leave, sick leave, and holidays.

CHEMICAL BRUSH CONTROL WORK ON ROADSIDES ON THE  
ANGELES AND SAN BERNARDINO NATIONAL FORESTS, 1949-1950

The chemical treatment on these forests was done during the months from February to August one season after cutting by the mowing machine. The new growth was from 8 to 18 inches high, similar to that shown below.



EQUIPMENT

A power spray pump was used with a 30-gallon tank mounted on a one-half ton pickup truck.

PRESSURE AND NOZZLES

Pressures varied from 30 to 35 pounds. Various fan type nozzles were used delivering 5.6 to 9.3 gallons per hour.

SPEED

Speed was held constant at 5 miles per hour.

CHEMICAL AND MIXTURES

A commercial product by the name of "Weedone Brush Killer 32" containing 2/3 pounds 2,4,5-T acid and 1-2/3 pounds 2,4-D acid per gallon was used in these tests. One to 1.5 gallons per acre of the chemical was used, mixed with diesel oil in proportions of one gallon of chemical to five gallons diesel oil.

## APPLICATION

For the most part, chemical was sprayed on one-year-old brush sprouts on the upper side of the road only by a man riding on the back of a pick-up with a 3/8-inch iron pipe boom. Attached to this boom were 3 fan-type nozzles which sprayed a strip 72 to 90 inches wide, depending on the kind of nozzles. This was the same boom as shown in the picture below.



On the whole, the work done on these two forests is very promising. With complete coverage of the leaves and stems of the plants, complete kill of some species and a retarded growth of the more resistant ones probably could have been attained.

## COSTS

Based on 20 to 25 miles of one side of road per day, the cost was about \$11.00 per mile, or \$22.00 per mile both sides, at 1950 prices.

## COMMENTS

In future work, the acids of 2,4-D and 2,4,5-T should be purchased separately rather than the commercial types of so-called "brushkillers," which contain a combination of both acids. By purchasing the acids separately any desired combination of the two can be obtained. For hard-to-kill species higher concentrations of 2,4,5-T are recommended. Better coverage and therefore fewer "misses" would have been obtained with a solid cone type of nozzle rather than the fan-type. Higher pressures and finer spray tips would also have contributed to more complete coverage.

## TRAILS

Practical experience in the treatment of brush along trails is limited to work done on the Angeles and San Bernardino Forests in 1950.

Two trails were treated—one side—a strip 6 feet wide and 4.5 miles long. A 4-gallon Hudson Pack Pump with a CO<sub>2</sub> charged power bottle, mounted on a pack frame, was used. The power bottle maintains adequate pressure and eliminates the need for manual pumping.

A commercial chemical containing 1-1/3 pounds of 2,4-D plus 2/3 pounds of 2,4,5-T per gallon was mixed with diesel oil in proportions of 1 to 4. The mixture was sprayed with a 24" boom equipped with a trigger-type shutoff valve and two fan-type nozzles with a discharge rate of 0.15 gpm.

Quantities of acid and diesel oil used per mile were: 0.75 pound of 2,4,5-T, 1.5 pounds of 2,4-D and 6.5 gallons of diesel oil.

